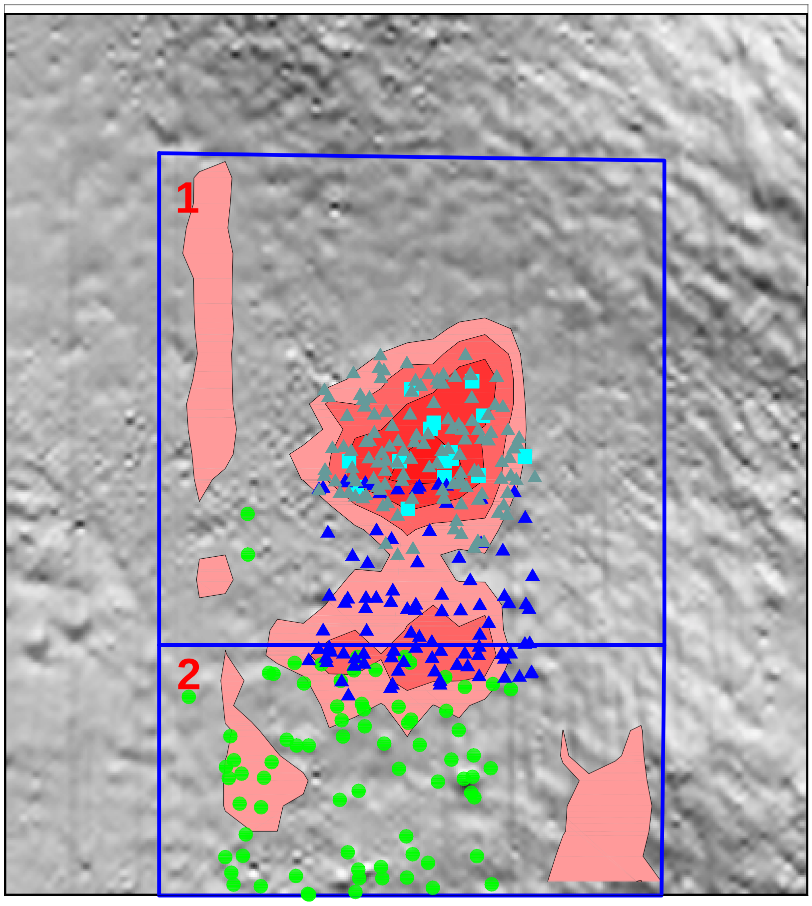
RESULTS FROM THE AUGUST 1999 BATHYMETRIC SURVEY OF HARS REMEDIATION AREAS 1 AND 2



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ACKNOWLEDGMENT

This report presents results of a bathymetric survey conducted at the Historic Area Remediation Site (HARS) by Science Applications International Corporation (SAIC) of Newport, RI, under Contract No. GS-35F-4461G with the U.S. Army Corp of Engineers – New York District (NYD).

Survey operations were conducted by SAIC staff: Messrs. Ed DeAngelo, Mike Cole and Dave Fischman, aboard the Corps M/V *Gelberman.* Dr. Stephen C. Knowles of the NYD provided logistical and planning support. The excellent vessel handling capabilities provided by the crew of the M/V *Gelberman* contributed significantly to the quality of the survey. Mr. Ed DeAngelo was the project leader for this Delivery Order and Dr. Scott McDowell was the Program Manager.

Mr. Jason Infantino produced the bathymetric data analysis and graphics. Mr. Ed DeAngelo and Mr. Jason Infantino authored the report. Mr. Ray Valente provided technical review of the report, while Mr. Tom Fox was responsible for report production.

1.0 INTRODUCTION

1.1 Background

Dredged material from the Port of New York and New Jersey has historically been placed in and around the Mud Dump Site (MDS), located in the open waters of the New York Bight six miles east of Sandy Hook, New Jersey. Based on concerns about limited site capacity and the environmental effects of past disposal, EPA Administrator Carol Browner, Secretary of Transportation Frederico Pena, and Secretary of the Army Togo West, Jr. issued a "3 Party Letter" in 1996 announcing the closure of the MDS by September 1, 1997. The "3 Party Letter" further states that simultaneous with the closure of the MDS, the site and surrounding areas which have been used historically for disposal of contaminated material will be redesignated as the Historic Area Remediation Site (HARS; Figure 1-1). On August 26, 1997, the U.S. Environmental Protection Agency (USEPA) and the U.S. Army Corps of Engineers (USACE) finalized the rule providing for simultaneous closure of the MDS and designation of the HARS.

Region II of the EPA and the New York District (NYD) of the USACE together are responsible for managing the HARS to reduce the presently elevated contamination and toxicity of surface sediments to acceptable levels. The two agencies have prepared a Site Management and Monitoring Plan (SMMP) for the HARS which identifies a number of actions, provisions and practices to manage remediation activities and monitoring. The planned remediation will consist of placing a one-meter "cap" layer of uncontaminated dredged material on top of the existing surface sediments within the 9 square mile Priority Remediation Area (PRA) of the HARS. The "remediation material" to be used for capping is defined as dredged material that meets current Category I standards and will not cause significant undesirable effects, including through bioaccumulation.

The main objective of the HARS SMMP is to ensure that placement of the remediation material does not result in any significant adverse environmental impacts but does result in sufficient modification (i.e., remediation) of currently unacceptable sediment chemistry and toxicity characteristics. Toward these ends, the SMMP includes a tiered monitoring program designed to focus both on the entire HARS and on each of the nine individual remediation areas in the PRA. The monitoring to be undertaken at regular intervals includes high-resolution bathymetry, sediment profile imaging (SPI), sediment coring, sediment chemistry and toxicity testing, tissue chemistry testing, benthic community analysis, and fish/shellfish surveys.

1.2 Survey Objectives

The main objective of this Delivery Order was to obtain high resolution bathymetric data for Remediation Areas 1 and 2 of the HARS (Figure 1-2) in order to detect changes in seafloor topography related to the placement of remediation material since September 1998. The information is also of use to determine the ability of the ADISS (Automated Disposal Inspection Surveillance System) scow positioning system to predict the position of mounds on the bottom formed from surface dredged material disposal. Survey information will also be used to document remediation activities in areas 1 and 2 of the HARS PRA and the surrounding buffer zone and detect all future depth changes associated with continued placement of remediation material in these areas.

Historic Area Remediation Site (HARS)

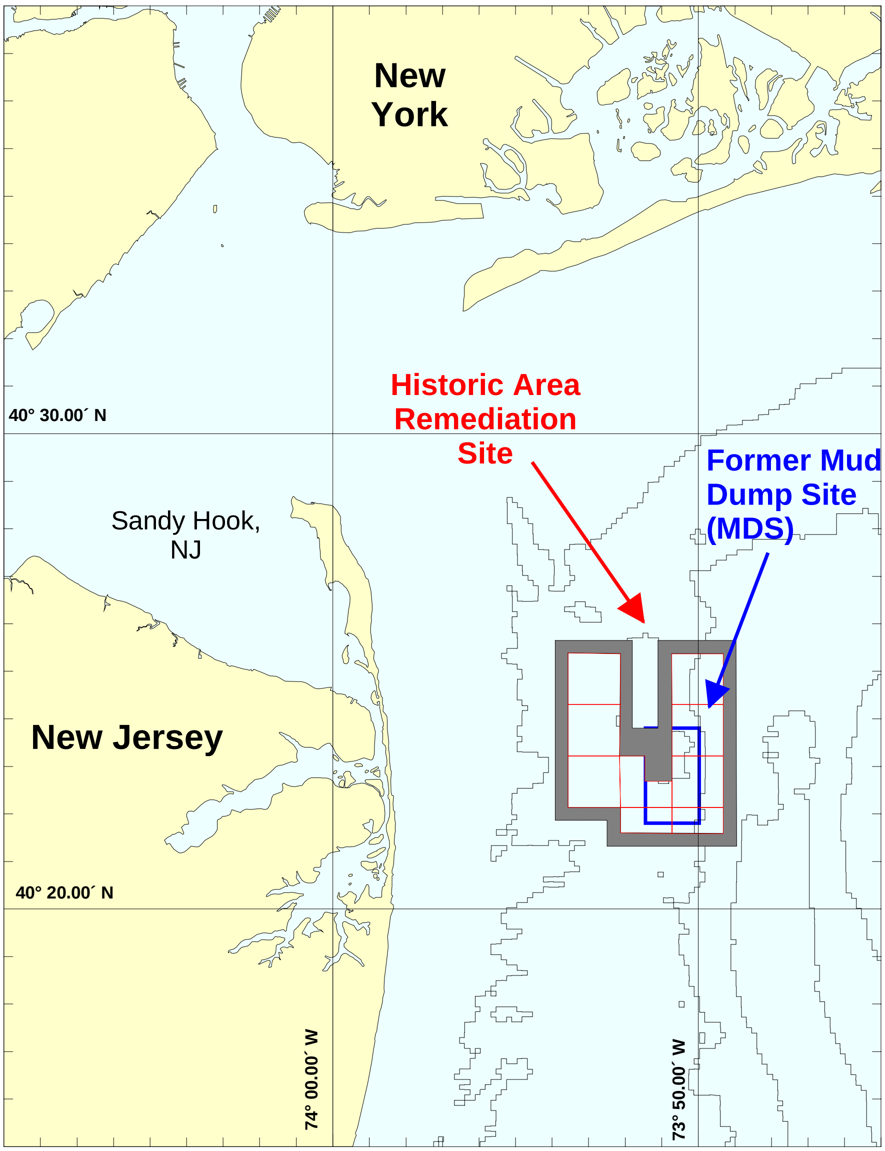

Figure 1-1. The location of the Historic Area Remediation Site in the New York Bight. The location of the Mud Dump Site is also shown.

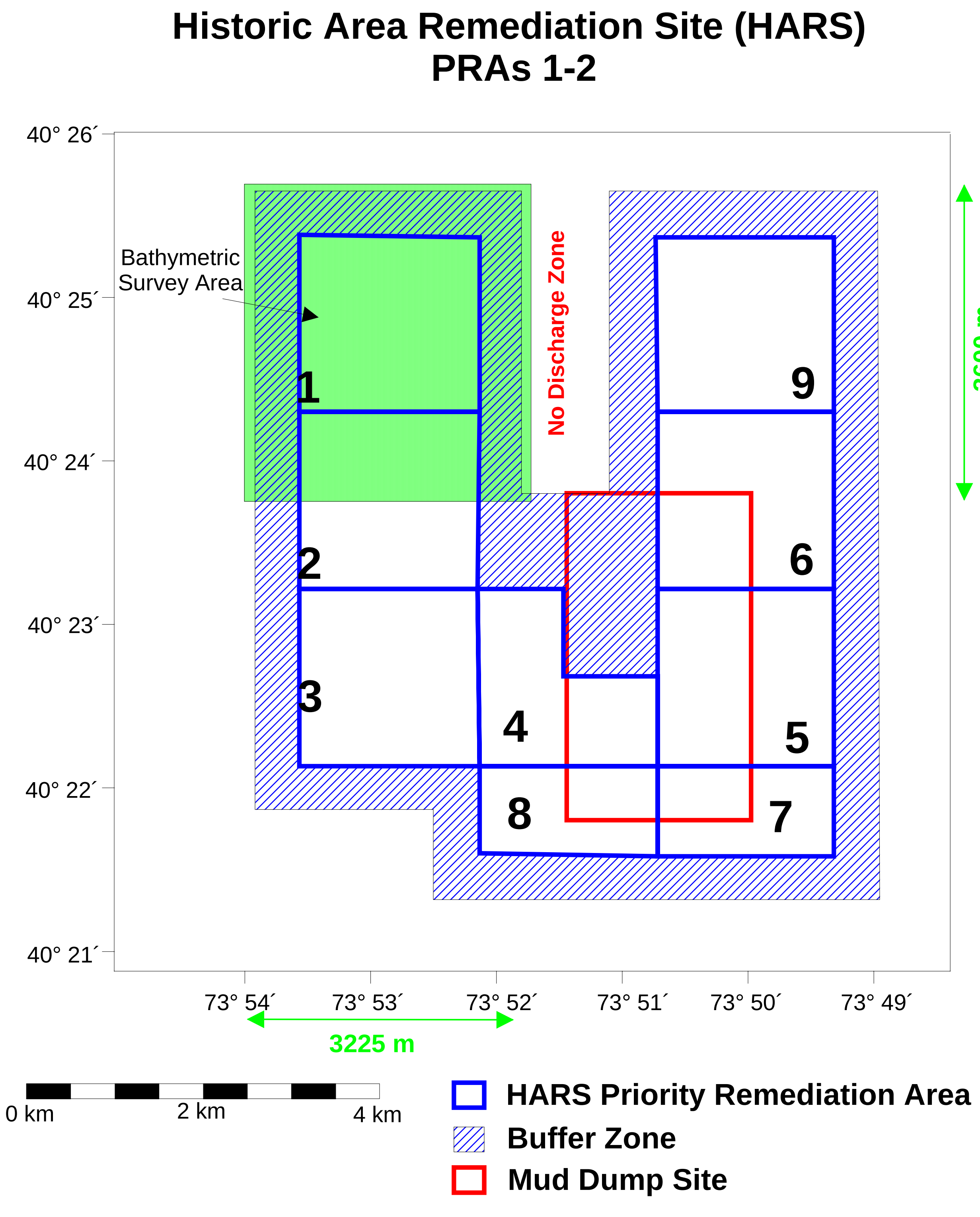

Figure 1-2. Map showing the nine Priority Remediation Areas (PRAs) which comprise the HARS. The August 1999 bathymetric survey area encompassing PRAs 1 and 2 is shown in green. The locations of the HARS buffer zone and the former Mud Dump Site are also shown.

2.0 METHODS

2.1 Bathymetric Survey Operations

Bathymetric survey operations at the HARS were conducted from August 17–26, 1999. SAIC scientists traveled to the Army Corps of Engineers, Caven Point Facility in Jersey City, NJ and installed navigation and bathymetric equipment to be used during the survey aboard the Corps' M/V *Gelberman*.

Vessel positioning and bathymetric data acquisition were achieved with SAIC's Portable Integrated Navigation Survey System (PINSS). The PC-based system provides real-time navigation and acquisition of position, time, and depth soundings for subsequent analysis. Vessel position was determined with a Trimble GPS. One to five meter position accuracy was achieved by applying correctors to the GPS signals which were acquired from a Differential GPS (DGPS) receiver. The DGPS received corrections from the USCG DGPS beacon located at Sandy Hook, NJ.

Depth soundings were collected with an Odom DF3200 Echotrac® survey echosounder using a 208 kHz transducer with a 3° beam angle. The Odom simultaneously displayed water depth data on a chart recorder and transferred digital sounding data to the PINSS. The echosounder collected 6–8 pings per second and transmitted an average value to the PINSS at a rate of one sounding per second.

A Seabird Electronics Inc., Model 19-01 conductivity-temperature-depth (CTD) profiler was used to acquire vertical profiles of sound velocity. Water column profiles were collected at the beginning and end of each survey day.

The bathymetric survey area measured 3,600 m (north-south) and 3,225 m (east-west) including PRA #1, the northern half of PRA #2, and the surrounding buffer zones to the North, East, and West (Figure 1-2). The survey consisted of 130 parallel survey lines spaced 25 m apart and oriented north to south. In addition, two east-west lines that extended the width of the study area were also surveyed to provide QA/QC information. Figure 2-1 displays a comparison of soundings along the main scheme north-south lines and two east-west crosslines.

2.2 Bathymetric Data Analysis

Using SAIC's Hydrographic Data Analysis System (HDAS), bathymetric soundings were edited for outliers and corrected for sound velocity and tidal variation. Following the application of all correctors, the depth soundings were spatially averaged to produce a bathymetric grid of cells each having dimensions 25 m by 25 m. The gridded bathymetric data were used to produce the various topographic maps included in this report, and will be incorporated into the GIS database of the Disposal Analysis Network for the New York District (DAN-NY) which resides at the New York District. Additionally, the bathymetric grid from this survey was compared with: 1) the September 1998 baseline bathymetric survey grid, to identify the total amount of cap material that had been deposited since the baseline survey was conducted and 2) bathymetric survey data collected in this part of the New York Bight in August 1995 and March 1996. Finally, the

Historic Area Remediation Site (HARS)
Bathymetric Survey, August 1999
Smooth Sheet with Crosslines #3 and #4

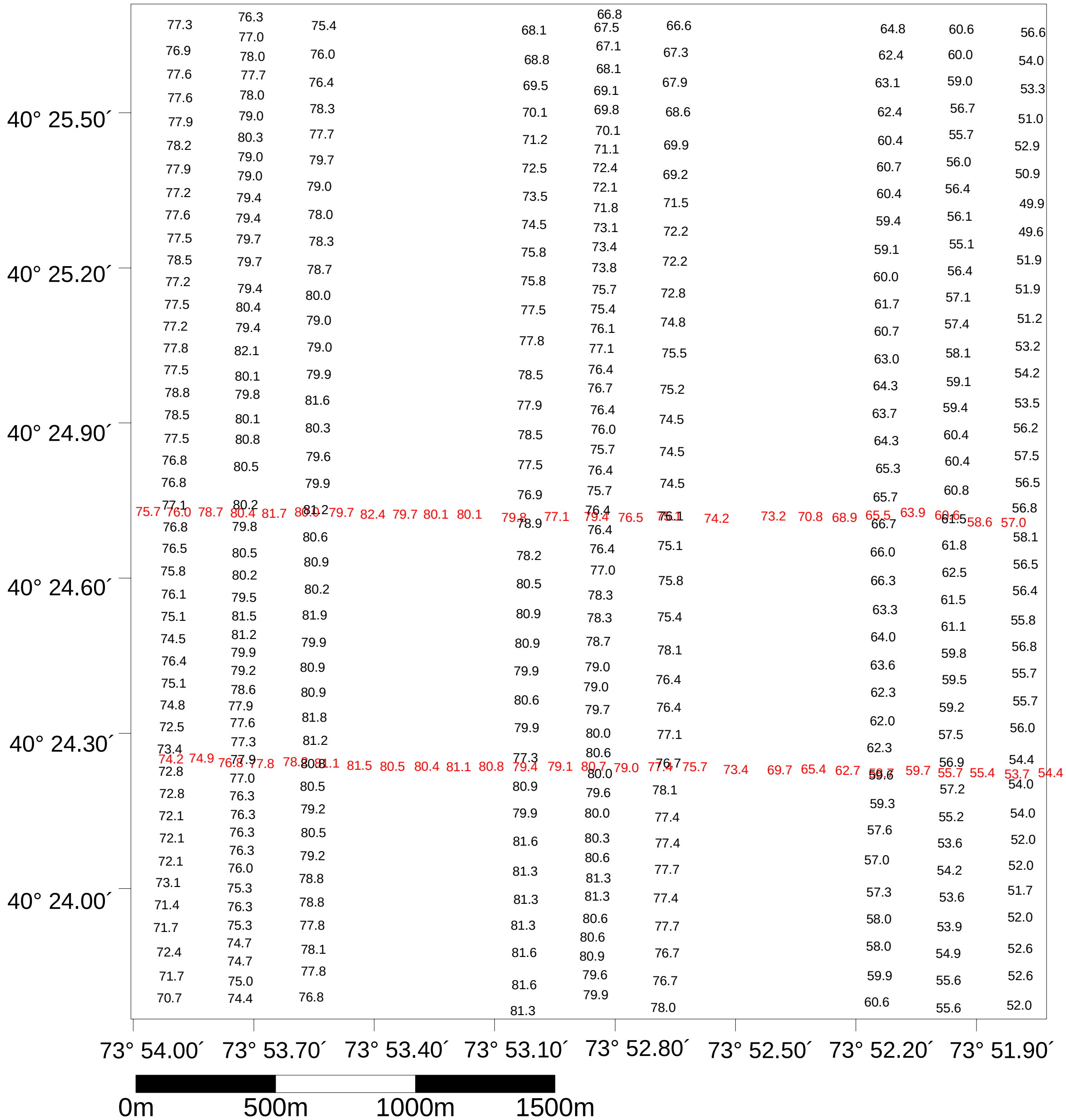

Figure 2-1. Main scheme depth soundings from the August 1999 bathymetric survey conducted at the HARS, plotted against Crosslines #3 and #4. Please note that these data were not corrected for heave and include wave and swell artifacts.

bathymetric survey results were used to examine the relationship between disposal locations at the sea surface (as determined through ADISS tracking of the disposal scows) and the location of topographic features (e.g., mounds) on the seafloor.

Water level data from the Sandy Hook, NJ, tide station were obtained from the NOAA Ocean and Lakes Levels Division (OLLD) web-server via the World Wide Web (http://www.opsd.nos.noaa.gov/). The NOAA station provides water level readings at 6-minute intervals referenced to Mean Lower Low Water (MLLW). Following the survey, the water level data from Sandy Hook were applied to the bathymetric data from the survey region to remove water level variations due to tides. Because the tide at Sandy Hook is 45 minutes later than the tide at the Mud Dump Site, a time adjustment was applied during the data processing.

3.0 RESULTS

3.1 Bathymetric Survey Results

The bathymetric survey results are presented in a variety of graphical data products to illustrate the topography of the study area. All graphic data products have been plotted in NAD83 latitude/longitude coordinates, and depth values are relative to Mean Lower Low Water (MLLW). For reference, the HARS PRAs 1 and 2, and the HARS buffer zone have been included in the plots.

Figure 3-1 is a two-dimensional plot of bathymetric contours within the survey area generated from the results of the August 1999 survey. A trough with a NW-SE orientation characterizes the topography in PRAs1 and 2. The deepest portion of the trough has a water depth of 80.5 ft and is located in the SW corner area of PRA 1. To the north and east, water depths decrease to 47.1 ft along the slope of an historic dredged material mound that accumulated in the early part of this century (SAIC 1995).

The color bathymetric contour plot represented in Figure 3-2 is useful for visual interpretation of the bathymetric survey results. The deepest (blue) regions towards the western central portion of the survey area contrast well with the shallower regions (yellow) to the northeast and to the southeast.

Three-dimensional contour plots are helpful for graphically portraying the topography of the survey area. For example, Figure 3-3 presents a three-dimensional view of the study area, looking northwestward. The deepest regions are in the foreground, while the shallowest area appears to the east. The topography to the southeast contrasts well with the relatively smooth topography in the northwestern area of the survey. The eastern portion of the survey area is composed of a relatively steep, linear slope oriented north and south. This slope feature serves as a natural border to the buffer zone of PRAs 1 and 2. Note that the steepness of the slope in the plot is misleading and a direct result of the vertical exaggeration in the figure. The depth axis in this figure has been stretched by a factor of 25:1 to exaggerate and better illustrate the topography. Please note that the apparent north-south striations are survey artifacts associated with the orientation of the survey tracklines.

Figure 3-4 presents a shaded relief perspective of the three-dimensional topography of the study area, illustrating the smooth topography of the northwestern portion of the survey area as compared to the mounds located centrally and to the south. The shading algorithms used in creating this plot enhance the visibility of small features on the seafloor. Although, some of the small features are artifacts related to the gridding methods, others are disposal mounds related to historic disposal events and more recent projects such as the Passenger Ship Terminal dredging project, which commenced in the spring of 1998 and can be seen in the center region of PRA 1. Correlation of these small features with recent disposal events will be discussed in the Section 4.2.

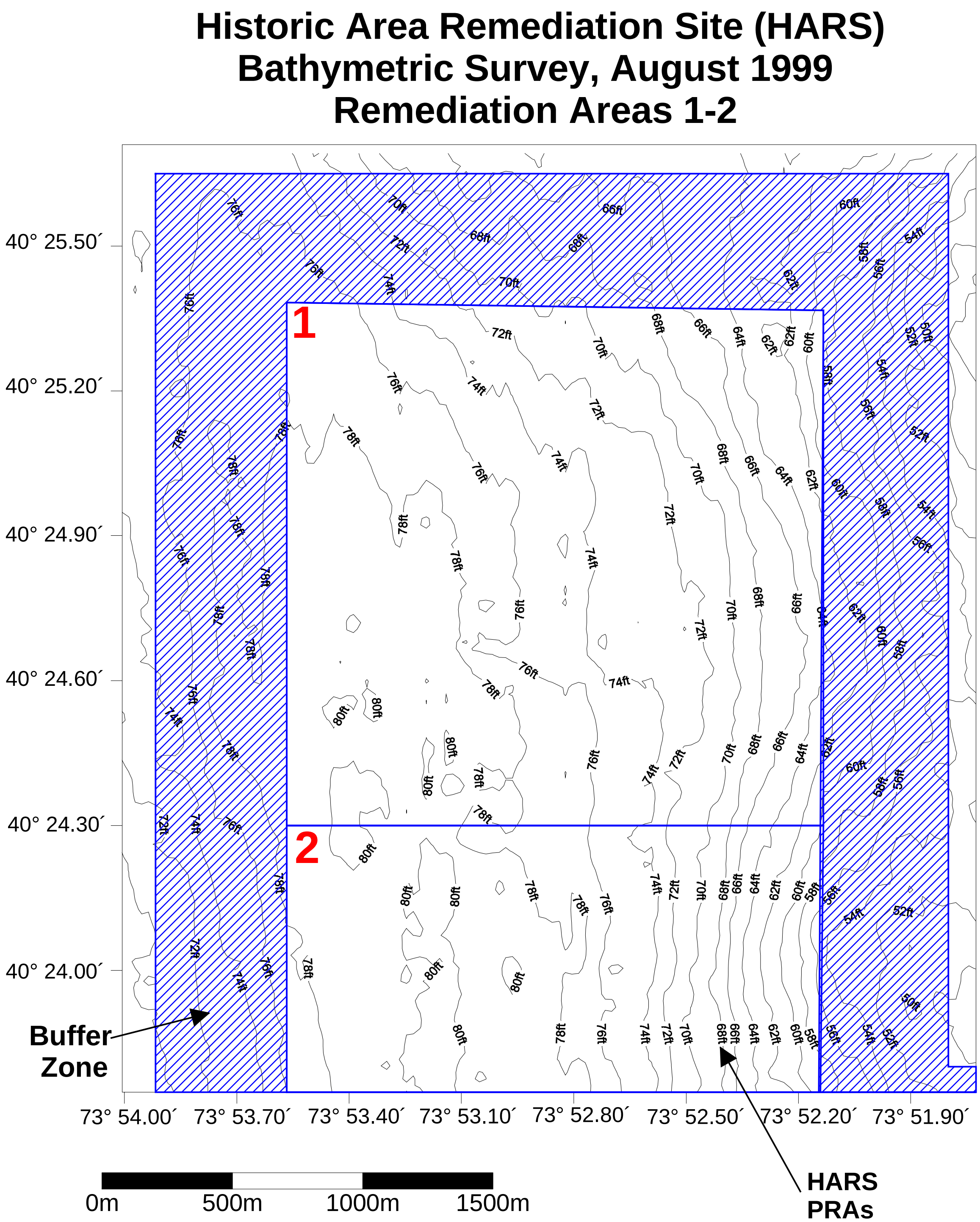

Figure 3-1. Two-dimensional color contour of topographic features within the HARS cells 1 and 2. In addition, the HARS buffer zone area has been included.

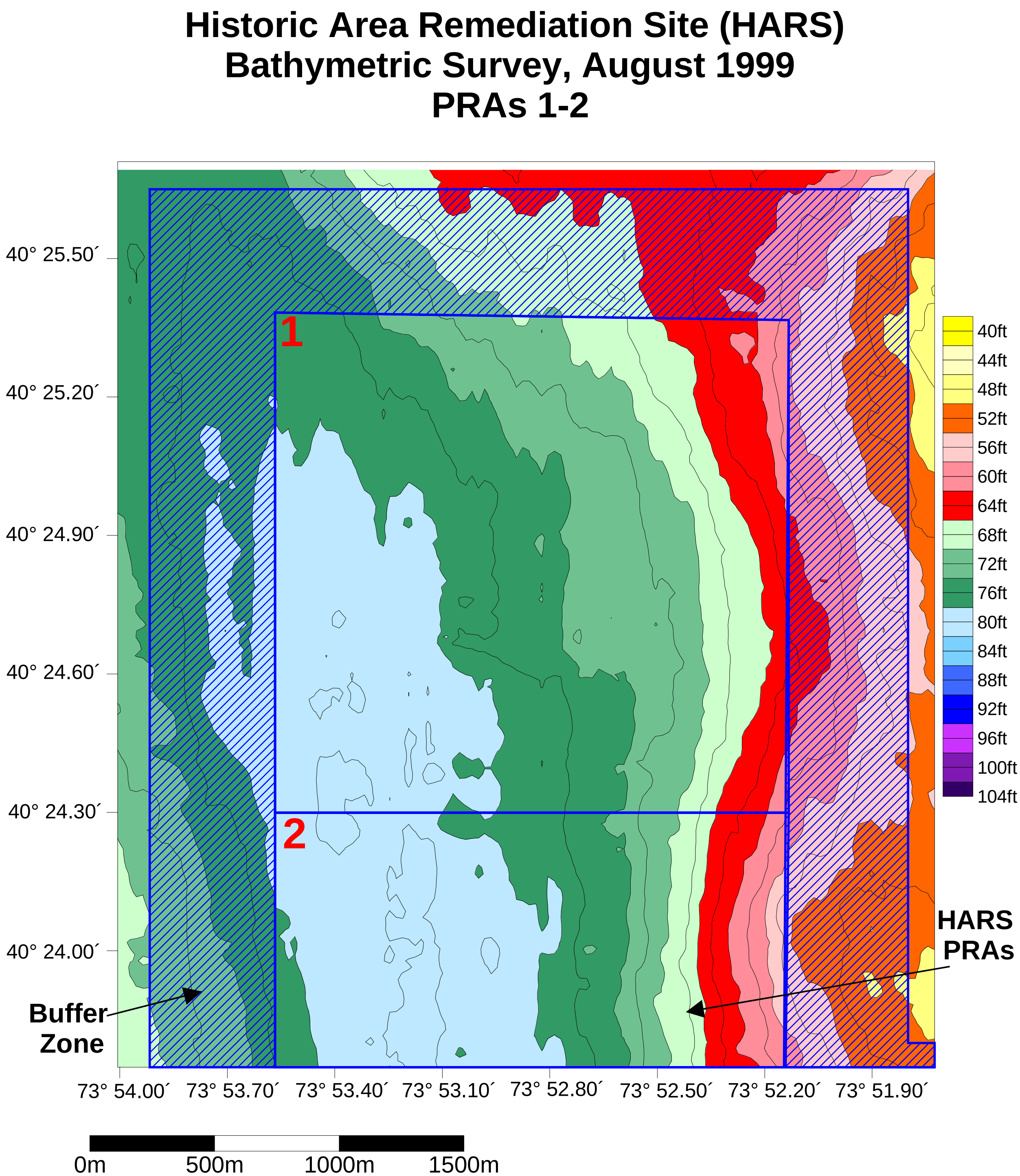

Figure 3-2. Two-dimensional color contour plot of topographic features within PRAs 1 and 2 and the surrounding HARS buffer zone.

Historic Area Remediation Site (HARS)
Bathymetric Survey, August 1999
PRAs 1-2

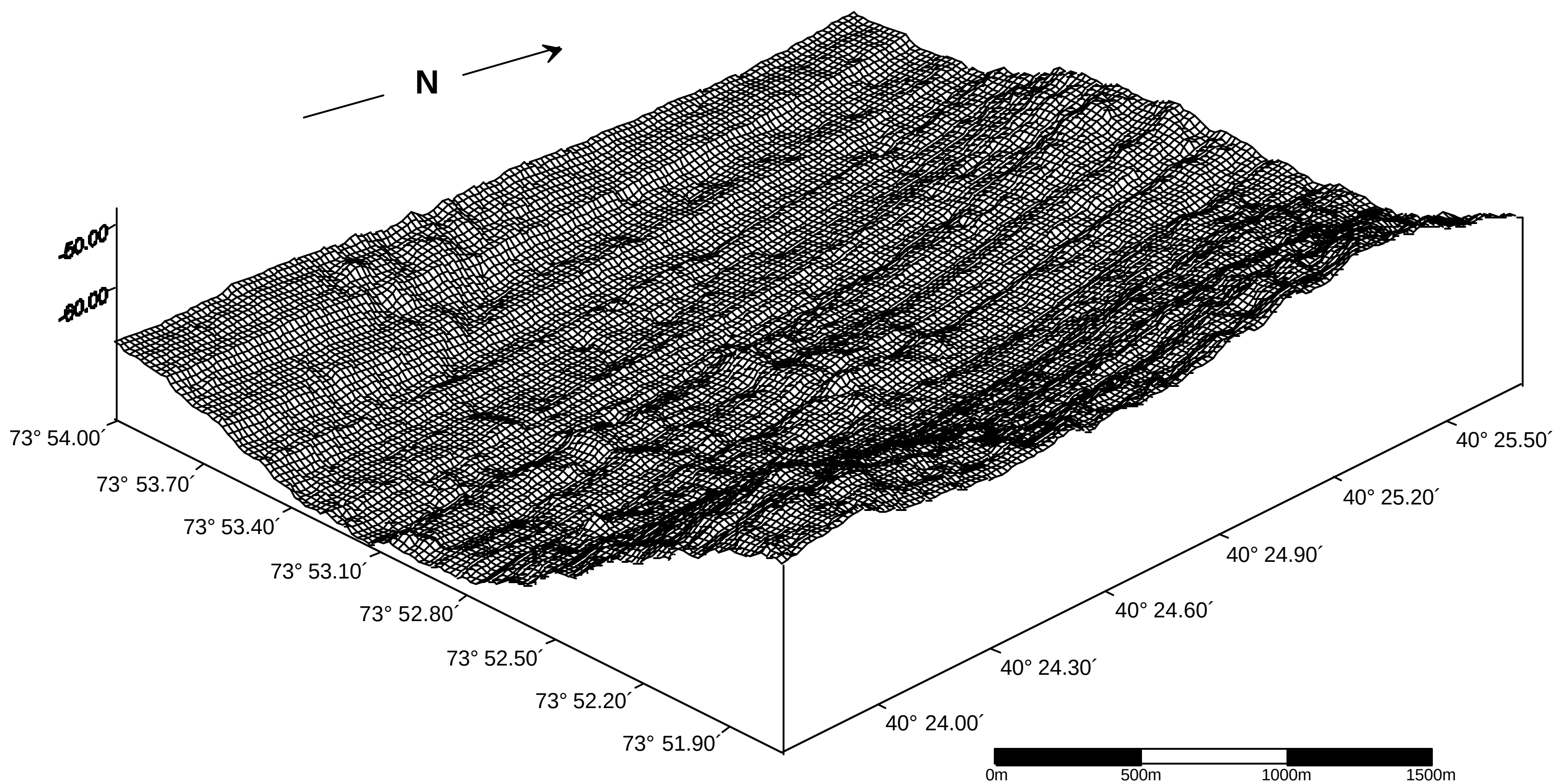

Figure 3-3. Three-dimensional mesh plot of the topographic features within PRAs 1 and 2. The vertical exaggeration in the figure is 25:1.

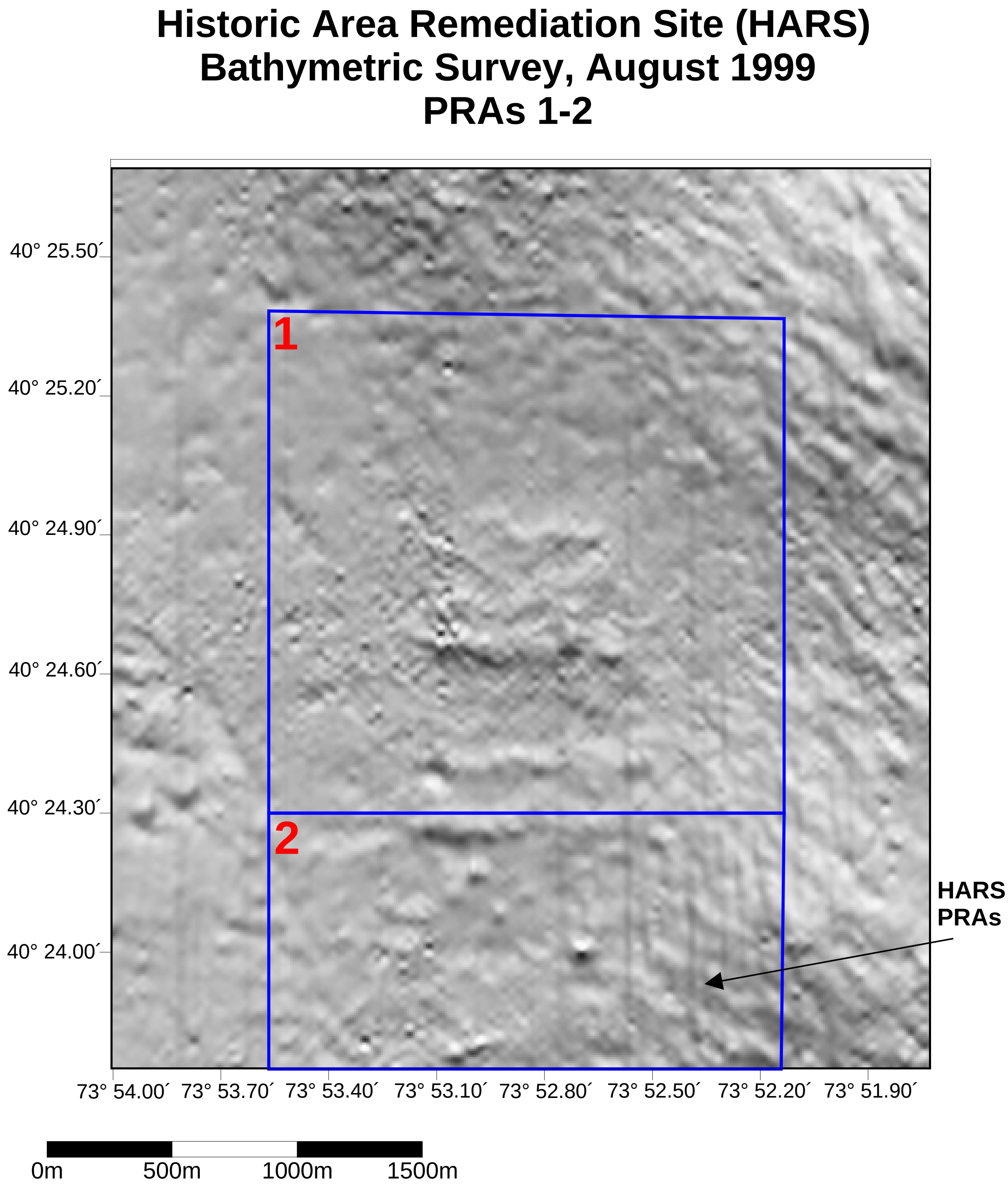

Figure 3-4. Shaded relief plot of the topographic features within PRAs 1 and 2.

3.2 Depth Difference and Volumetric Analyses

3.2.1 Comparison with September 1998 Bathymetric Results

Quantitative comparison of the bathymetric results between the September 1998 (SAIC 1998a) and August 1999 surveys yields valuable information on depth differences resulting from disposal operations conducted within PRAs 1 and 2. Gridded data from the surveys were compared by algebraically subtracting the September 1998 grid from the August 1999 grid.

Figure 3-5 presents a two-dimensional plot of the depth difference results from the comparison between the September 1998 and August 1999 surveys. The results are based on grids with a 25-m cell size. This figure effectively illustrates the area where the accumulation of remediation material is concentrated. Near the center of PRA 1 there is accumulation of two small mounds each covering an area of approximately 200 m east-west by 300 m north to south and ranging in thickness from 0.5 ft to 2 ft. Near the boundary between PRAs 1 and 2, a larger accumulation of material was observed, covering an area of approximately 1,250 m east-west by 500 m north-south and ranging in thickness from 0.5 ft to 2.5 ft. PRA 2 shows the extension of mound accumulation to the north central boundary of the area that extends to the central portion of the survey area as well. The figure also illustrates some noise that was introduced to the data through possible survey artifact differences such as survey line offsets between the baseline and interim surveys respectively or small tidal discrepancies. The noise lies within the +/-0.5 ft resolution limits and can be seen to be randomly dispersed throughout the reported area.

The depth difference results were used to estimate the volume of material that had been deposited on the seafloor from the beginning of remediation activities in September 1998 until the recent survey of August 1999. Comparisons over the entire survey area show total positive volume (gain of material) of 630,000 yd^3. However, this volume estimate includes difference values below the 0.5 ft detection limit. The inclusion of even these small difference values, integrated over the large survey area, can result in an overestimation of the associated volume. To address this error, the volume of material with thickness values that exceeded the 0.5 ft detection limit (as illustrated in Figure 3-5) was calculated to be 206,000 yd^3.

3.2.2 Comparison with 1995/1996 Bathymetric Results

The August 1998 bathymetric survey of HARS PRAs 1,2, and 3 was conducted after the disposal of approximately 500,000 yd^3 of the remediation material in PRA 1 (SAIC 1998b) and therefore, is not a suitable “baseline” for evaluating the total amount of remediation material placed at the HARS. In order to account for all of the material that has been placed at the HARS, the August 1999 survey data were also compared with topographic information collected during both the 1995 Expanded Mud Dump (SAIC 1995) and the 1996 Northwest Box (SAIC 1996) surveys.

Figure 3-6 is a two-dimensional plot of bathymetric contours within the survey area generated from the results of the 1995 Expanded Mud Dump and the 1996 Northwest Box surveys. Because the boundary between the 1995 and 1996 surveys lies near the center of HARS PRA 1, data from both surveys were used to generate one complete “baseline” grid for comparison to the

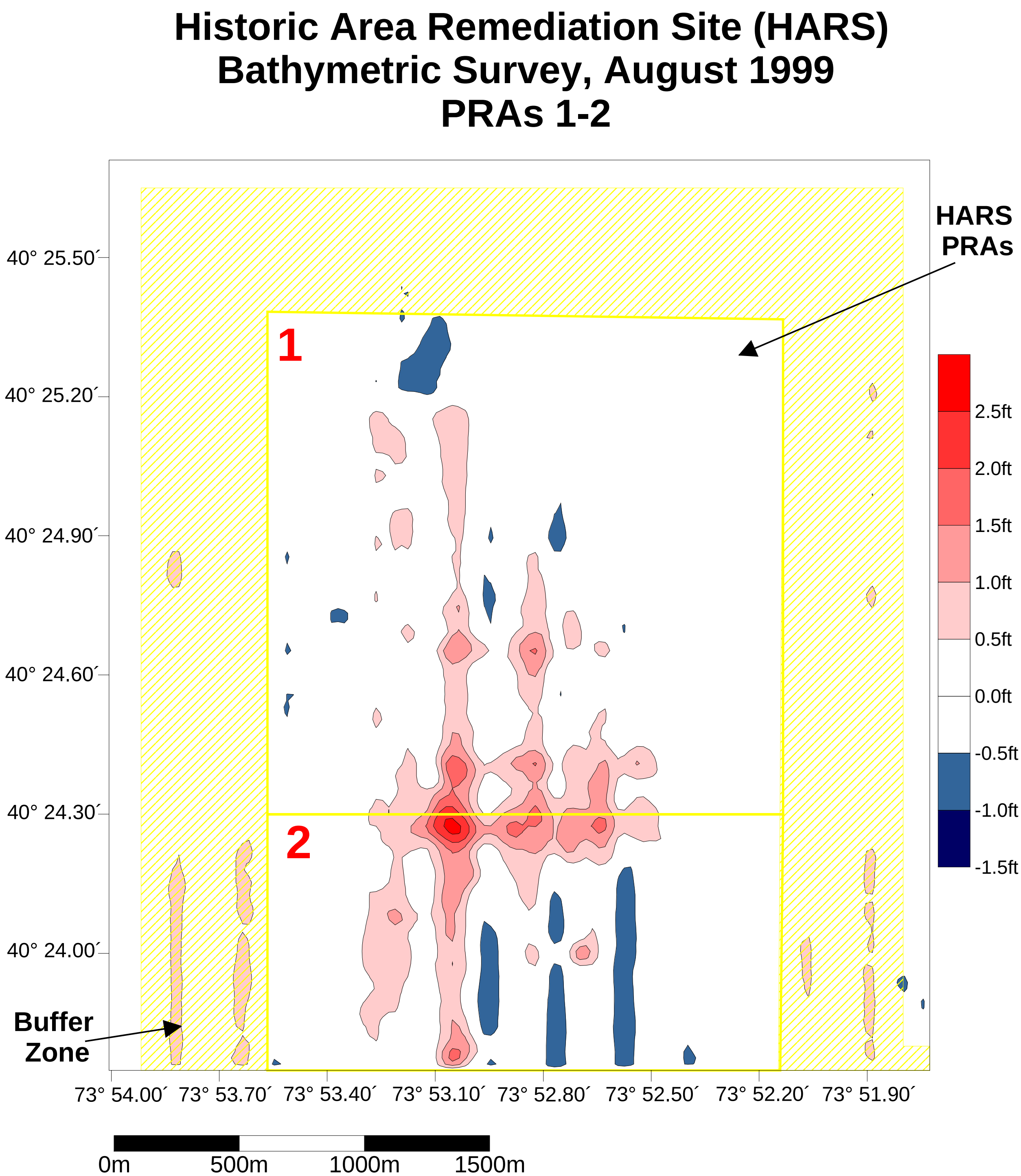

Figure 3-5. Map of color contours which illustrate the depth difference between the August 1998 and September 1999 bathymetric surveys of PRAs 1 and 2 and the surrounding buffer zone.

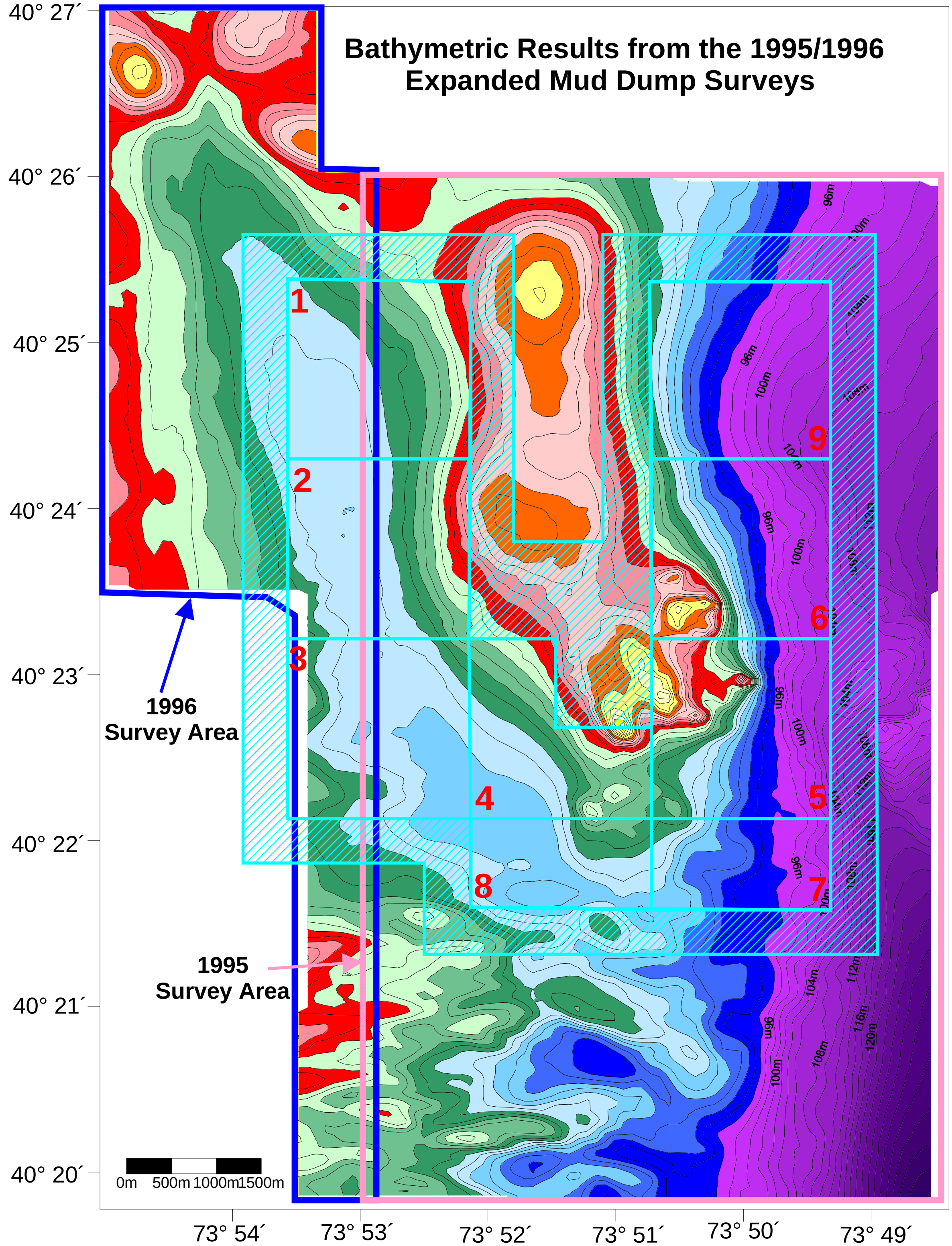

Figure 3-6. Two-dimensional color contour map of topographic features from the 1995/1996 Expanded Mud Dump Site surveys.

August 1999 HARS survey. Both the 1995 and 1996 surveys were conducted at a 100 m line spacing, which limits the resolution of the associated gridded matrix to cells with 100 m square dimensions. As such, the August 1999 HARS survey data were re-gridded at the same 100 m grid cell resolution for the following depth difference analyses.

Figure 3-7 illustrates a two-dimensional plot of depth difference results between the combination of the 1995/1996 Expanded Mud Dump Site baseline surveys and the August 1999 interim survey at 100 m grid resolution. As in Figure 3-5, depth changes of >0.5 ft have been plotted for comparison between the separate depth difference analyses. However, because this figure represents information that has been integrated over large grid cells (100m x 100m), the confidence in the minimum 0.5 ft detection level is degraded to a level closer to 1 ft.

The positive difference values in Figure 3-7 cover an area of the seafloor approximately 2,000 m east-west by 2,500 m north-south. In the central region of PRA 1, there is a well-defined mound footprint covering 1,000 m east-west by 800 m north-south and ranging in thickness from 0.5 ft to 2.5 ft. This mound combines to the southern portion of the region with a second large mound covering about 800 m east-west by 800 m north-south and ranging from 0.5 ft to 1.5 ft. The second mound apex is located in the middle of the boundary between PRAs 1 and 2.

In the buffer zone east of PRAs 1 and 2, large apparent positive depth differences were observed along the sloping bottom of an historic disposal mound. These apparent mounds are the result of survey artifacts associated with spatial differences between programmed survey transects from 1995 and 1999 compounded by the integration of difference values over large, 100 m grid cells. Figures 3-8 and 3-9 are used to illustrate this artifact. Two pairs of survey track lines were extracted from the 1995/1996 and 1999 databases, one line from each survey was located over both a flat bottom area to the west and the steep slope area to the east. The spatial location of these lines are plotted in Figure 3-8 in relation to the bottom topography and the grid cells used in the depth difference analysis. Figure 3-9 displays a profile plot of the depth data from each survey line. In the flat bottom (low slope) regions, small spatial difference in track lines have negligible impact on the measured water depth. However, on highly sloping bottoms as found in the eastern buffer zone, small spatial differences between survey tracks can greatly affect the measured water depth.

The depth difference results were used to estimate the volume of material that had been deposited on the seafloor from the beginning of remediation activities at the HARS. To reduce this error, the volume of material with thickness values that exceeded the 0.5 ft detection limit (as illustrated in Figure 3-7) was calculated to be 875,000 yd^3. It is important to note that this estimate assumes a 0.5 ft minimum thickness detection level. The 0.5 ft detection level was used so that the analysis would be consistent with the depth differencing between the 1998 and 1999 databases.

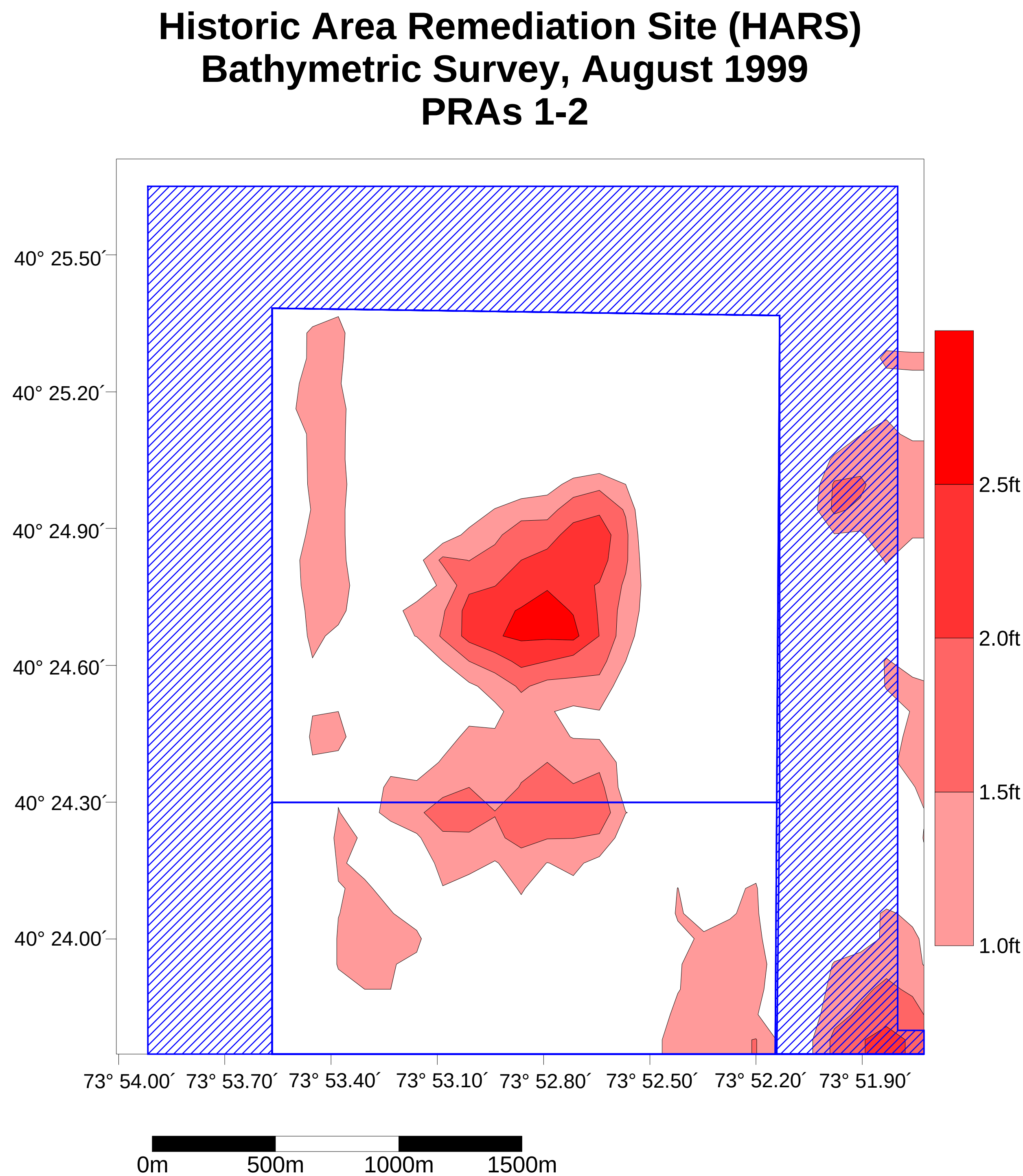

Figure 3-7. Depth difference color contours between the baseline 1995/1996 and the September 1999 bathymetric surveys. In addition, the HARS buffer zone area has been included.

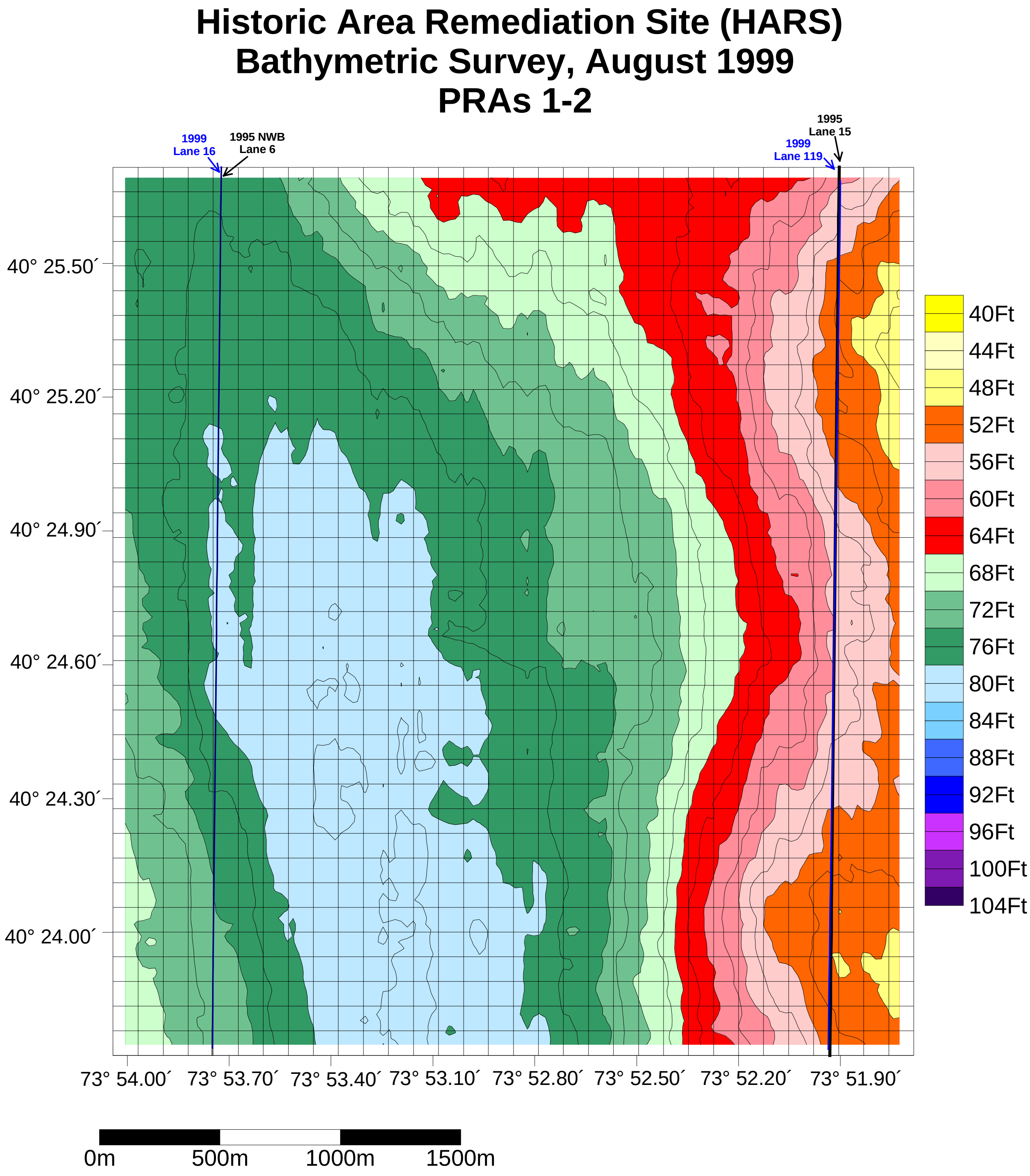

Figure 3-8. Two-dimensional color contour of topographic features within PRAs 1 and 2 with the grid cells superimposed. In addition, the HARS buffer zone area has been included. Analogous survey-lines from the 1995/1996 and 1999 surveys have been plotted over both flat and sloping bottom areas.

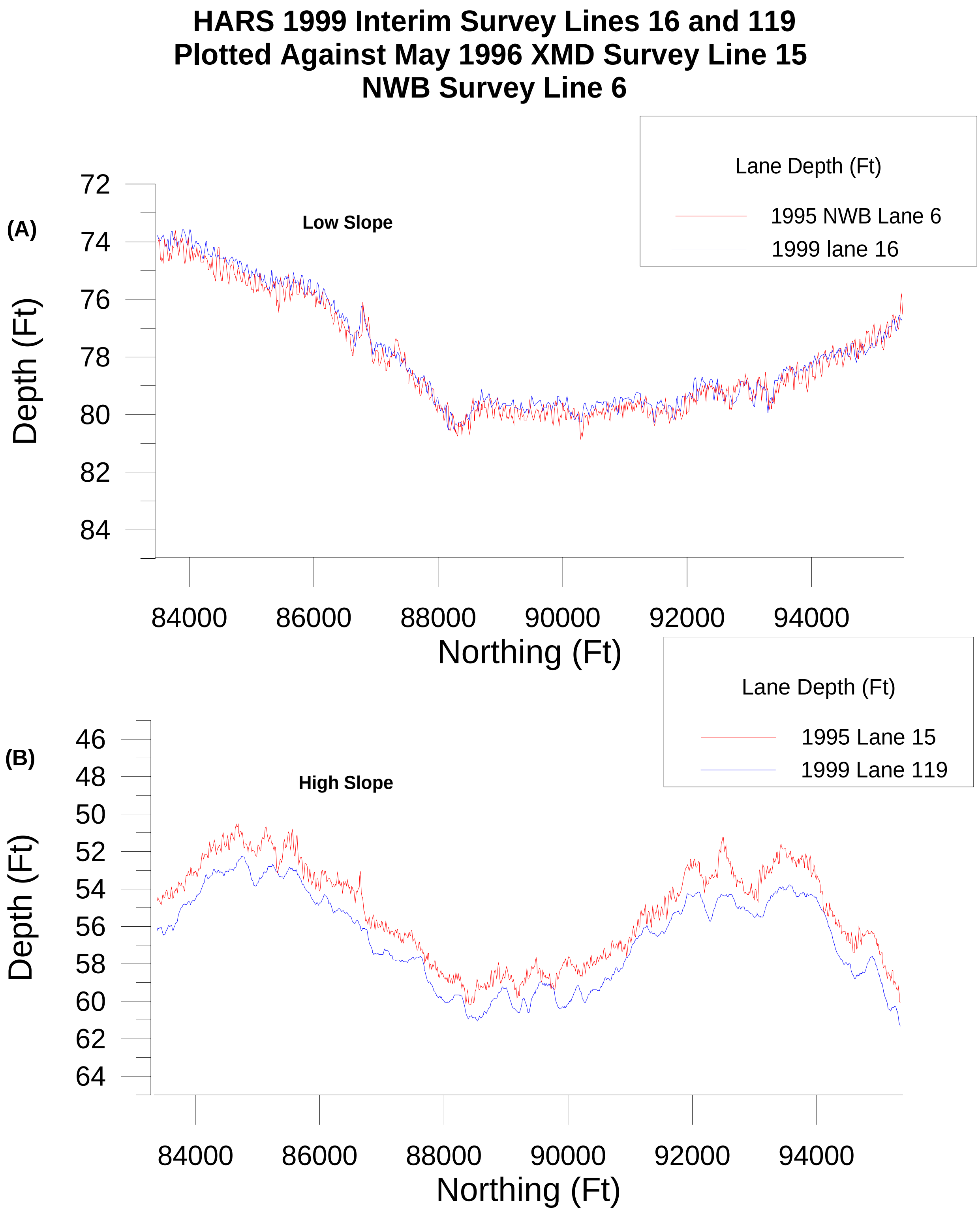

Figure 3-9. A cross-sectional view of analogous survey lines: 1995/1996 baseline surveys versus the August 1999 survey. (A) represents survey lines sampled over a flat bottom and (B) represents survey lines sampled over a sloping bottom.

4.0 DISCUSSION

The August 1999 high-resolution bathymetric survey of HARS PRAs 1 and 2 was performed to detect changes in topography resulting from the placement of remediation material. HARS site managers at the USACE and EPA will use this information to assess the current status of the on-going remediation activities and to plan for future placement of remediation material.

4.1 Placement of Remediation Material at the HARS

Since establishment of the HARS in September 1997, a total of four dredging projects have placed remediation material there (Table 4-1). Material dredged from the ITO Passenger Ship Terminal in 1998 and 1999 (SAIC 1998b, SAIC 1999) and the Jack Frost Refined Sugar Docks (SAIC 1998c) was placed in PRA 1, while material from the Kill Van Kull (KVK) Channel Deepening Project is currently being placed in PRA 2.

In order to determine the spatial extent and thickness of the remediation material that has been placed at the HARS, the August 1999 bathymetric survey results were compared to topographic data collected by SAIC in 1995/1996 and 1998 during previous surveys in the HARS area. The comparison with each historic dataset includes its own set of limitations. For example, during bathymetric survey of the HARS PRAs 1–3 conducted in September 1998, data were collected at the same high-resolution spatial scales (25 m) as the most recent August 1999 survey. This allows for the detection and measurement of topographic changes with a high degree of precision.

Table 4-1

Projects and Estimated Volumes of Remediation Material Placed at PRAs 1 and 2

Project Name	Completion Date	Recorded Log Disposals	Recorded ADISS Disposals	Total Volume (yd^3)*
ITO Passenger Ship Terminal	April 1998	134	129	481,000
Jack Frost Refined Sugar	November 1998	18	18	56,000
ITO Passenger Ship Terminal	May 1999	115	94	342,000
Kill Van Kull (on-going)	As of August 26, 1999	47	47	145,000
TOTALS		**314**	**288**	**1,024,000**

*Note: Volumes reported are estimates from Disposal Inspector scow logs and represent estimate maxima.

However, the September 1998 survey was conducted after a considerable volume of dredged material (~ 500,000 yd^3) from the ITO Passenger Ship Terminal was placed in PRA 1. Because the 1998 survey occurred after the placement of the ITO material, that material is not accounted for in depth-difference (Figure 3-5) and volumetric analyses between the 1998 and 1999 surveys. Therefore, the comparison between the 1998 and 1999 bathymetric datasets does not provide a complete picture of what has been placed at the HARS to date.

Prior to the establishment of the HARS, SAIC conducted low resolution (100 m line spacing) reconnaissance bathymetric surveys in the regions surrounding the Mud Dump Site during the 1995 Expanded Mud Dump Site (SAIC 1995) and 1996 Northwest Region surveys (SAIC 1996). The results from these two surveys have been identified as “baseline” conditions in the HARS SMMP. Use of these historic datasets in depth difference analyses will account for all four projects that have placed material at the HARS. However, the low resolution of these historic datasets limits the accuracy and precision with which remediation material layers on the seafloor of the HARS can be detected because changes are integrated over larger spatial scales.

4.1.1 Remediation Material Placement between September 1998 and August 1999

The results of the depth difference analysis between the August 1999 and September 1998 bathymetric datasets displayed in Figure 4-1 suggest that only a small portion PRA 1 has been covered with a measurable layer of (>0.5 ft) of remediation material. The largest concentrations of the remediation material were observed at the boundary between PRAs 1 and 2. The remediation material appears as a complex of five to six small mounds with maximum thickness values ranging from 1–2.5 ft. Two smaller mounds were also observed near the center of PRA 1 and within PRA 2.

Included in Figure 4-1 are the disposal patterns (grid cells) that were used to direct the placement of remediation material at the HARS between September 1998 and August 1999. Material from the Jack Frost Sugar Refinery was placed in specific quadrants of concentric circles while the ITO Passenger Ship Terminal and KVK 1999 dredging projects were directed to individual cells making up an evenly spaced grid pattern. The results from the depth difference analyses clearly show that the placement of remediation material has been confined to the desired disposal locations. The mound complexes observed on the seafloor of the HARS align closely to the individual disposal cells. This alignment successfully demonstrates the ability of disposal site managers at the ACOE and EPA to accurately guide the placement of remediation material at the HARS

Bathymetric depth differencing techniques detected 206,000 yd^3 of material on the seafloor at the HARS associated the placement of remediation material. This calculated bathymetric volume represents an estimation of the true, due to the +/-0.5 ft detection limit of the bathymetric differencing techniques and also in part to possible horizontal sampling artifacts.

4.1.2 Remediation Material Placement since September 1997

The low resolution comparisons between the 1995/1996 baseline bathymetric data and the most recent August 1999 data provide a useful overview of the current status of remediation at the HARS. Though it may not be as suitable for delineating small spatial scale features as the 1998 to 1999 comparison, it does allow the site managers to assess which areas of the HARS are nearing completion with respect to remediation material placement.

Historic Area Remediation Site (HARS)
Bathymetric Survey, August 1999
PRAs 1-2

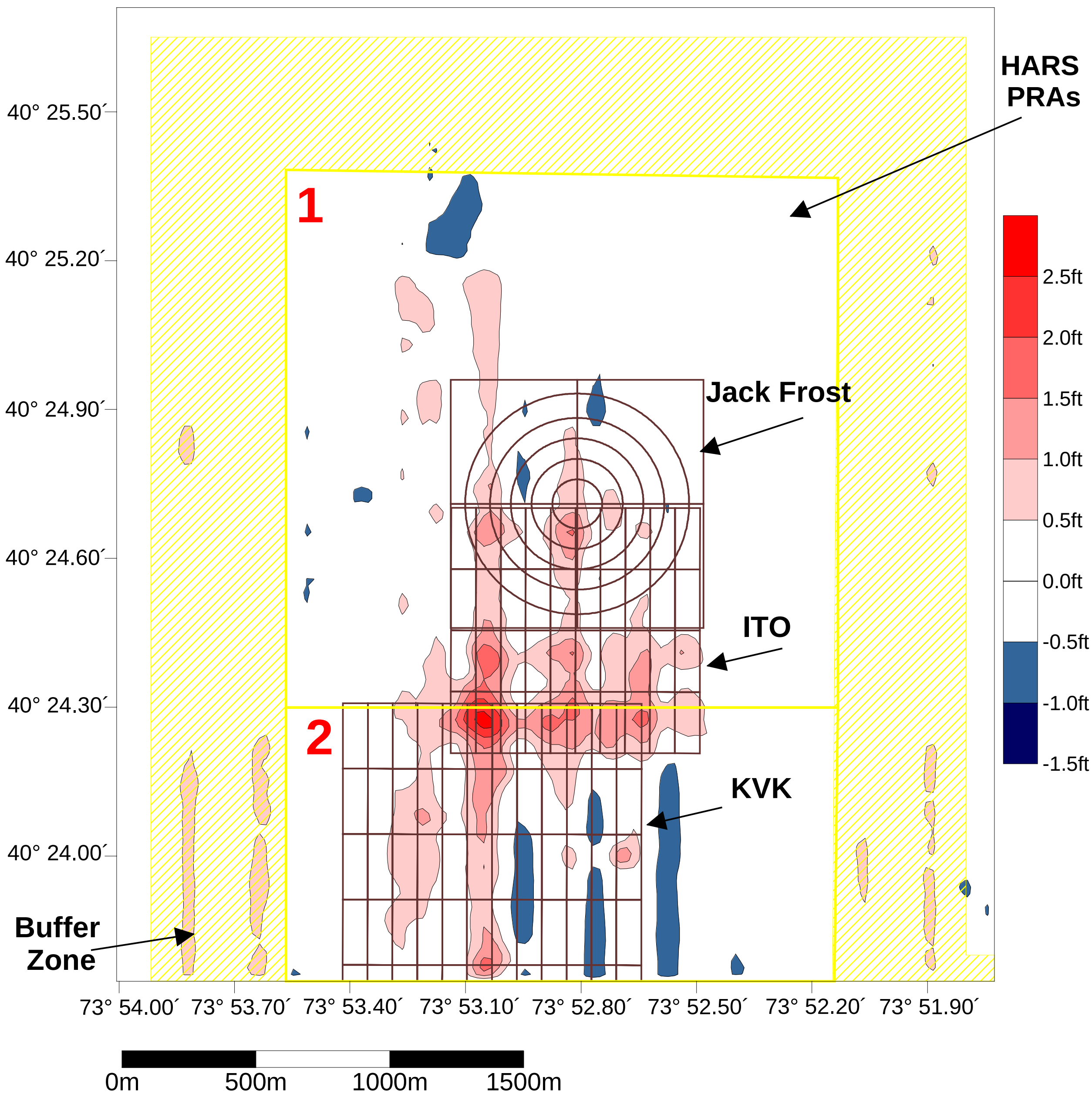

Figure 4-1. Depth difference color contours between the August 1998 and September 1999 bathymetric surveys. The HARS buffer zone area has been included. In addition, the target disposal grid patterns for Jack Frost, ITO - 1999, and KVK have been plotted.

As of August 1999, no portion of HARS PRAs 1 or 2 had been completely capped with a layer of remediation material at least 3 ft thick. Accumulations in excess of 2.5 ft were observed near the center of PRA 1 and at the boundary between PRAs 1 and 2. The results of the comparison between the 1995/1996 baseline and 1999 interim surveys demonstrate that a large portion the HARS PRAs 1 and 2 have been covered with at least a minimal amount of remediation material.

Bathymetric monitoring techniques detected 875,000 yd^3 of remediation material on the seafloor of the HARS, excluding the survey artifacts observed in the buffer zone. This value is approximately 15% lower than the 1,024,000 yd^3 estimated from scow logs. It is not unexpected that the detected volume of remediation on seafloor would be lower than the reported scow volumes. During the dredging process, large volumes of water are introduced to dredged material slurry placed in the scow. Once the material is placed on the seafloor, it is normal to expect a reduction in volume due to the loss of entrained pore water during consolidation. Thus, it is expected that the volume of consolidated dredged material detected on the seafloor using acoustic techniques will be less than that estimated visually in the scows prior to disposal.

4.2 Comparison with ADISS Disposal Records

During each of the four dredging projects that placed material at the HARS, SAIC installed the Automated Disposal Inspection Surveillance System (ADISS) aboard the disposal scows (SAIC 1998b and c; SAIC 1999). ADISS was installed on the disposal scows to accurately monitor scow position and draft during (1) loading at the dredging site, (2) transit, and (3) disposal. Data were acquired in near real-time via ARGOS satellite or during service trips to the scow(s). The disposal information recorded with the ADISS during the two ITO, Jack Frost, and KVK dredging projects was archived and incorporated into the DAN-NY database.

During the disposal operations the ADISS provided a 92% data return rate, successfully recording 288 out of a total 314 disposal events at the HARS for the four projects. Figures 4-2 through 4-5 present the location of disposal events within the HARS that have been recorded by the ADISS during each of the individual disposal projects. For reference, the recorded disposal points and target grids have been plotted over a shaded relief representation of the August 1999 topographic information. There was generally good agreement between small topographic features on the seafloor and location of the disposal events recorded with the ADISS.

Figure 4-6 illustrates the relationship between the ADISS disposal events and the actual disposal accumulations as determined by coarse scale depth differencing. All of the ADISS events from September 1998 through August 1999 are plotted and include a total of four disposal projects. At the (blue) boundary line between area 1 and 2, there is a close correlation between the mounds that stretch from west to east and the (ITO) Passenger Ship Terminal disposal points that overlie them. The combination of the Jack Frost and ITO disposal projects correlate with the formation of a mound in the north central survey area. To the south the relatively recent KVK disposal events yield some small accumulations. Notice that there is apparent accumulation in the western portion of PRA1 and the eastern portion of PRA 2. The accumulation values lie within the 0.5-1 ft thickness interval, which are within the detection limits for the 1995/1996 and 1999 datasets. Again the 0.5 ft interval was reported in the datasets in order to be consistent with the differencing between the 1998 and 1999 datasets.

Historic Area Remediation Site (HARS)
Bathymetric Survey, August 1999
PRAs 1-2

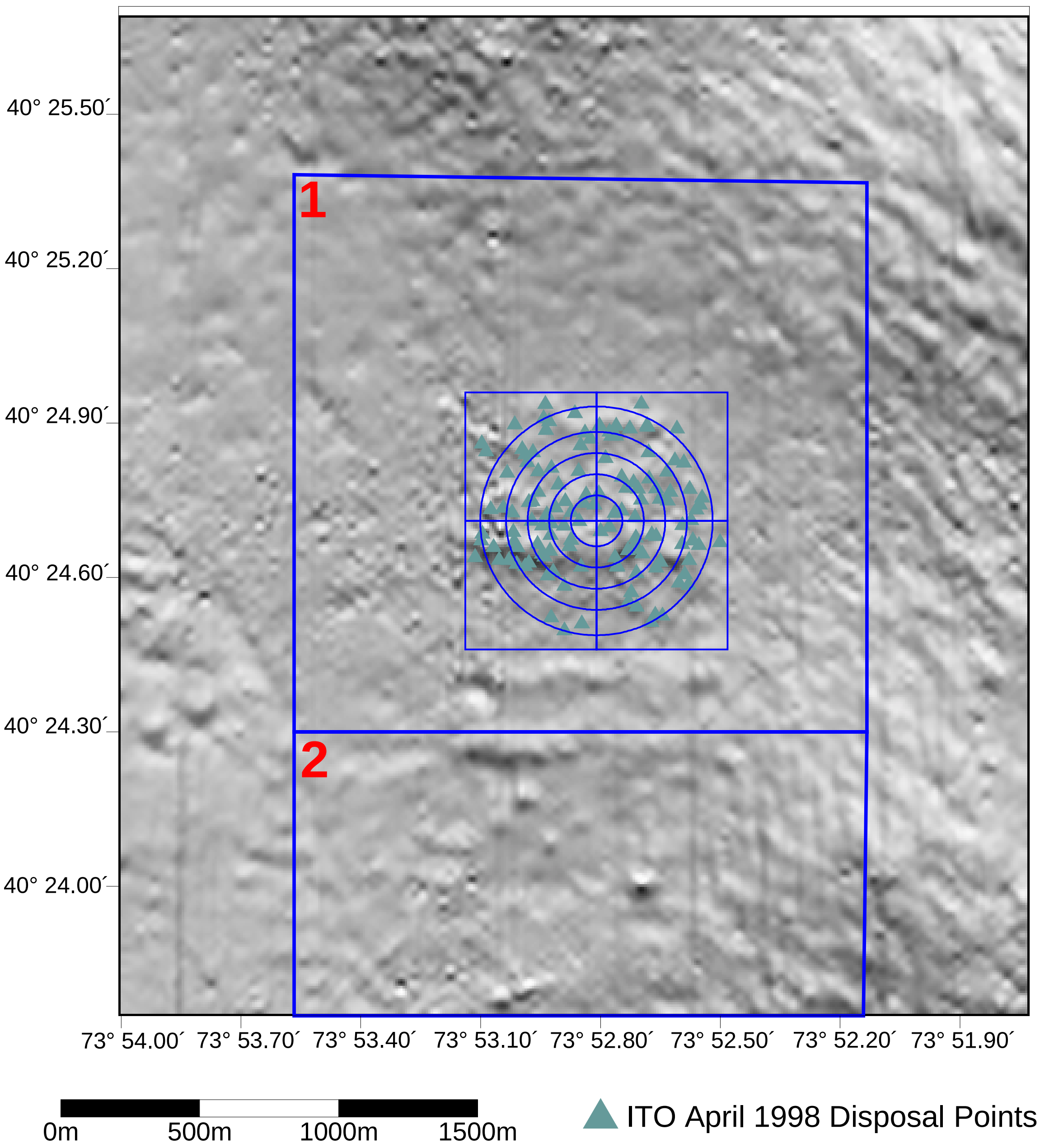

Figure 4-2. Shaded relief plot of the topographic features within PRAs 1 and 2 along with plotted disposal points from ADISS data collected during the 1998 ITO Passenger Ship Terminal Project.

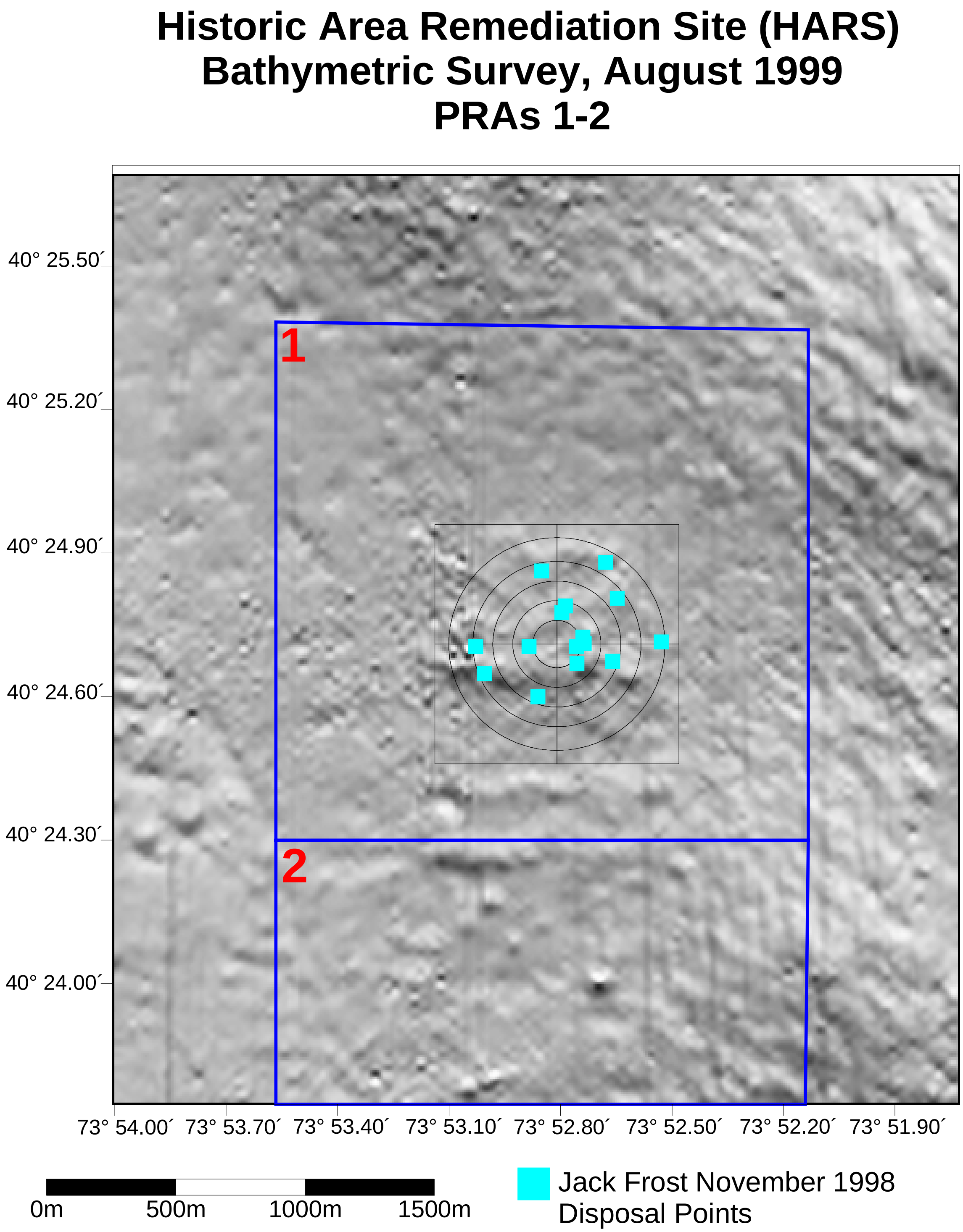

Figure 4-3. Shaded relief plot of the topographic features within PRAs 1 and 2 along with plotted disposal points from ADISS data collected during the 1998 Jack Frost Refined Sugar Dredging Project.

Historic Area Remediation Site (HARS)
Bathymetric Survey, August 1999
PRAs 1-2

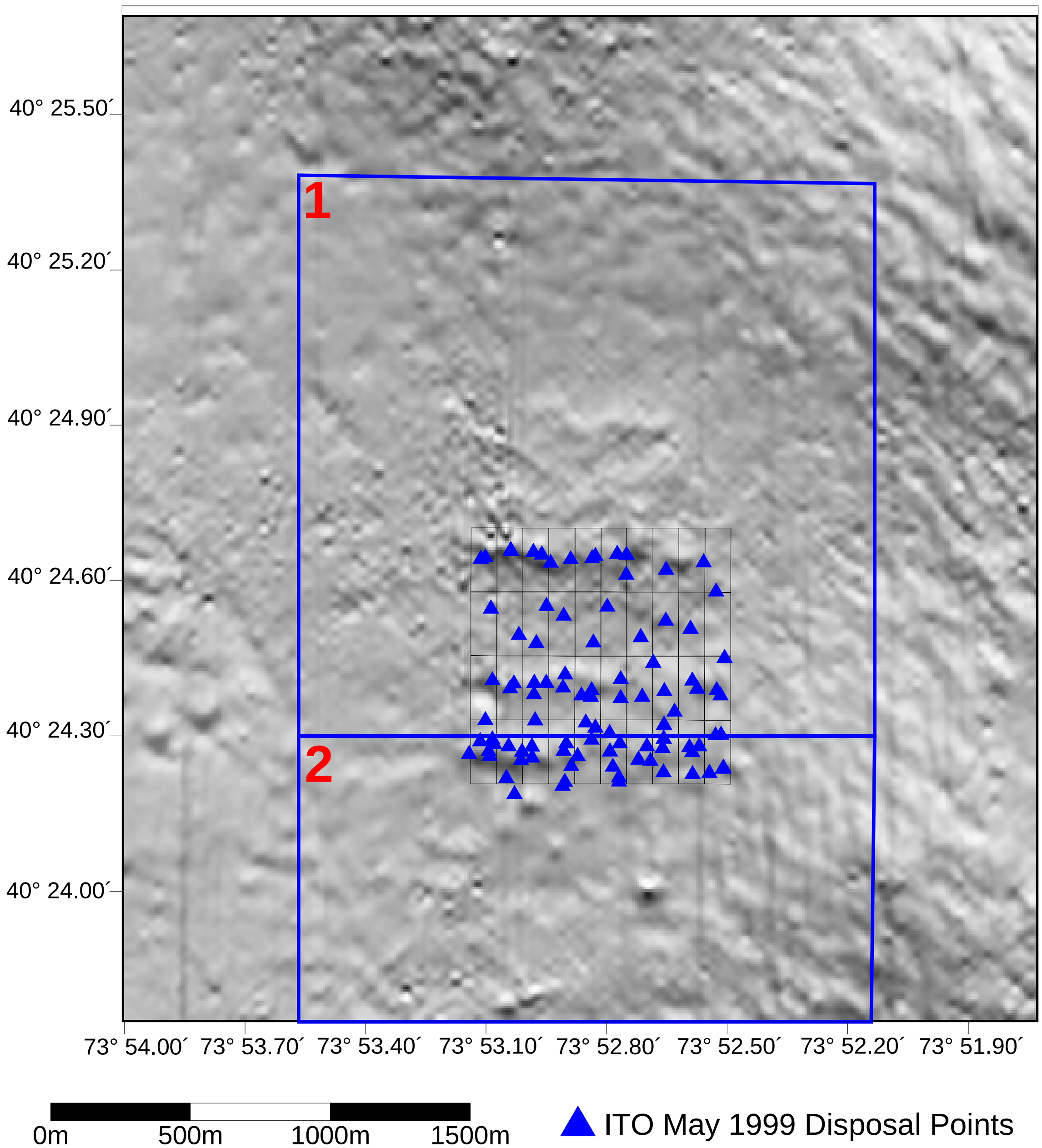

Figure 4-4. Shaded relief plot of the topographic features within PRAs 1 and 2 along with plotted disposal points from ADISS data collected during the 1999 ITO Passenger Ship Terminal Project.

Historic Area Remediation Site (HARS)
Bathymetric Survey, August 1999
PRAs 1-2

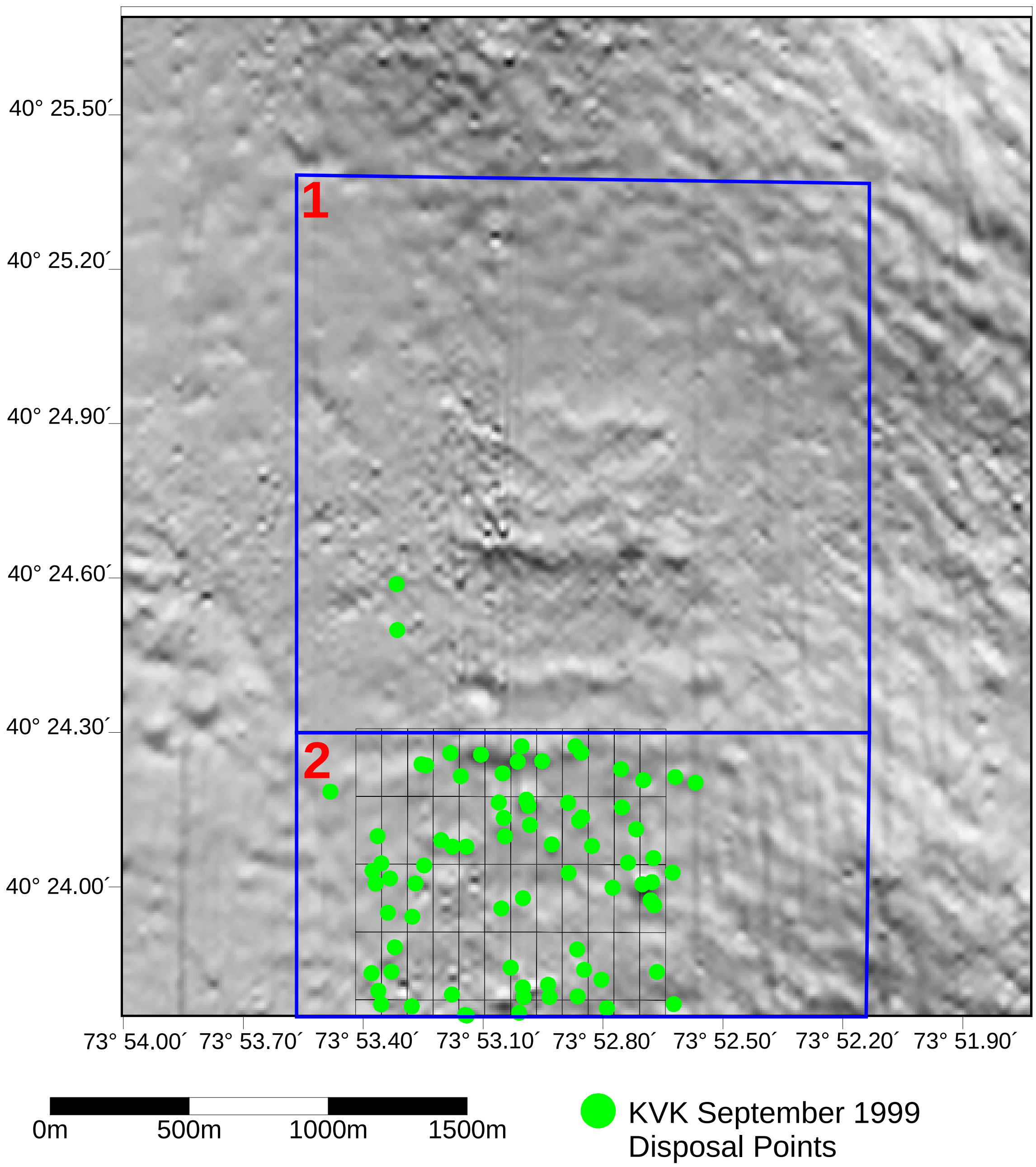

Figure 4-5. Shaded relief plot of the topographic features within PRAs 1 and 2 along with plotted disposal points from ADISS data collected during the1999 KVK Project.

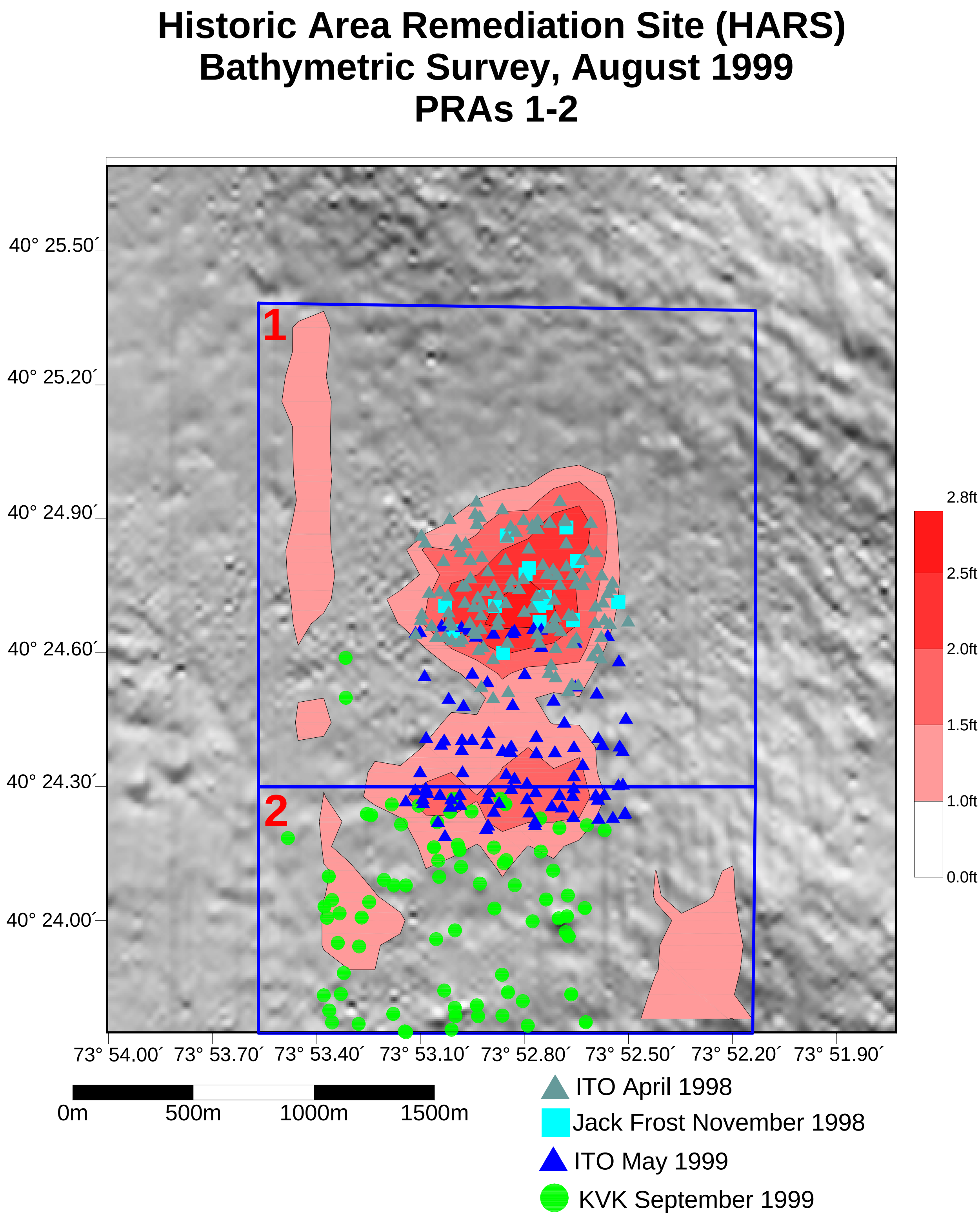

Figure 4-6. Shaded relief plot of the topographic features within PRAs 1 and 2 along with plotted disposal points from ADISS data collected during March 1998 to September 1999. Depth difference contours are from the comparison of the 1995/1996 baseline survey to the August 1999 interim survey.

5.0 CONCLUSION

The objectives of the August 1999 Interim HARS bathymetric survey were twofold: 1) to collect high resolution topographic information to be used for determining the status of on-going remediation activity, and 2) evaluate the ability of the ADISS scow positioning system to predict the position of mounds formed on the bottom. The data results presented in this report fulfill both objectives.

Through depth differencing techniques, it is estimated that approximately 875,000 yd^3 of remediation material has been placed at the HARS since its opening in September 1997. Remediation material layers with a maximum thickness in excess of 2.0 ft were observed in mound formations near the center of PRA 1 and at the boundary with PRA 2. Thin deposits of remediation material with thickness values ranging from 0.5 ft to 1.0 ft were observed throughout PRA 1 and in PRA 2 in association with the on-going KVK dredging program.

The correlation between disposal events recorded with ADISS scow positioning system and topographic features identified with high-resolution single-beam bathymetry demonstrates the ability and usefulness of ADISS for predicting the position of disposal mounds formed on the bottom. The ADISS scow positions correlated well with both large-scale features such as the large mound developed during the 1998 ITO and Jack Frost projects and small-scale features identified. This ability will prove useful for future disposal programs at the HARS, especially when remediation is nearing completion. Areas deficit in remediation material, identified through bathymetric difference techniques, can accurately and predictably be targeted for disposal. Disposal events in these areas can be recorded and verified by site managers in near real-time with the ADISS scow positioning system.

6.0 REFERENCES

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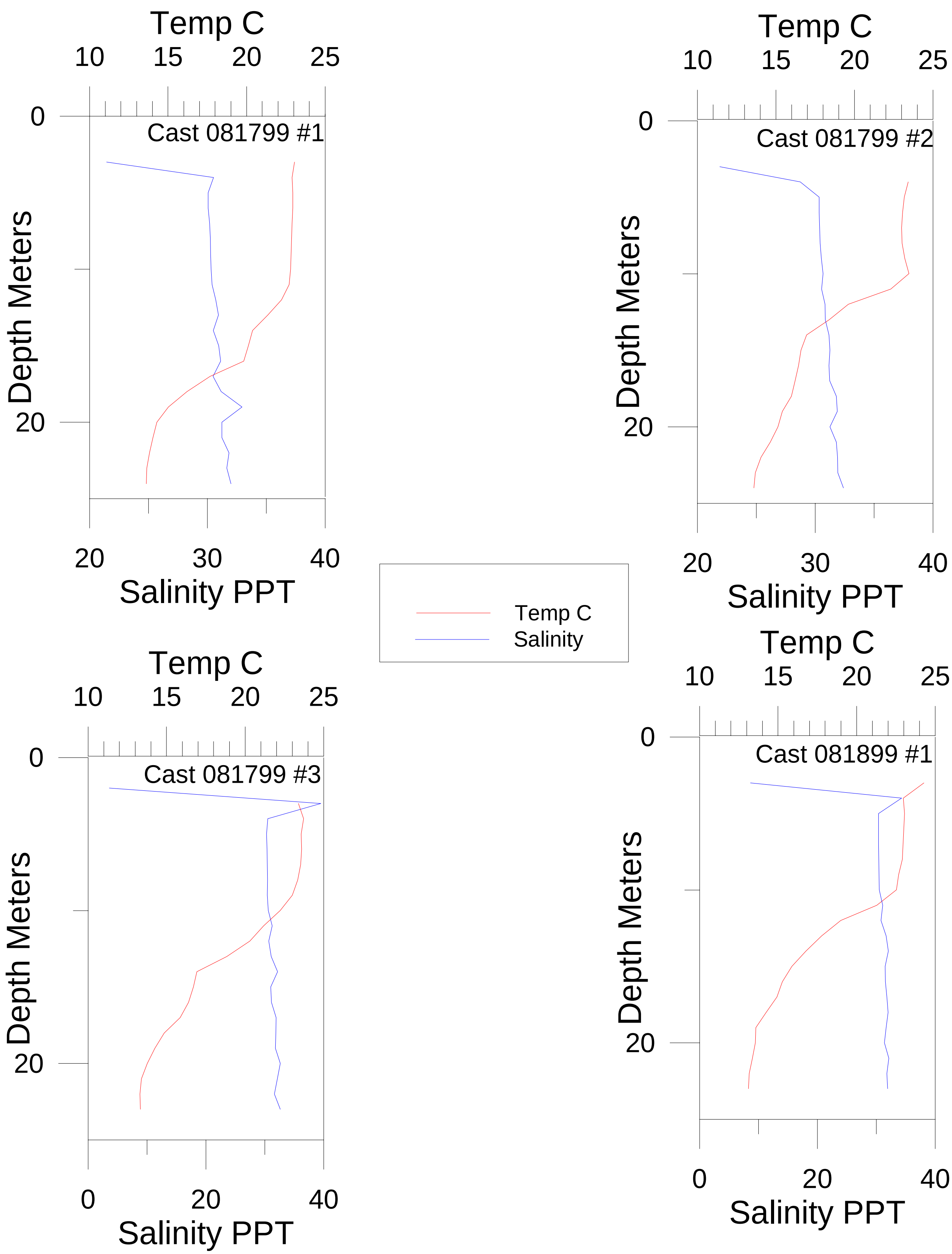
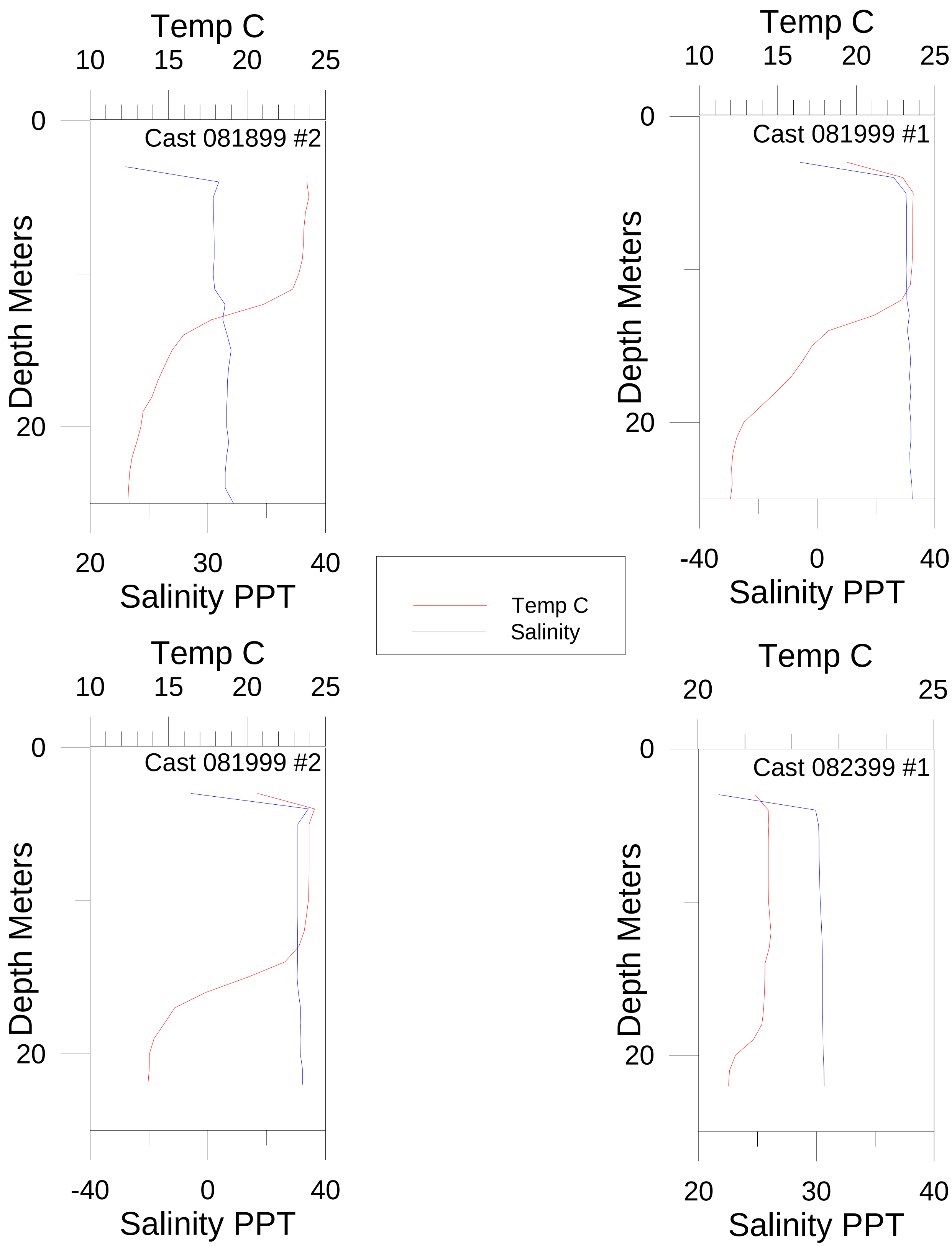
Appendix A
CTD Profiles

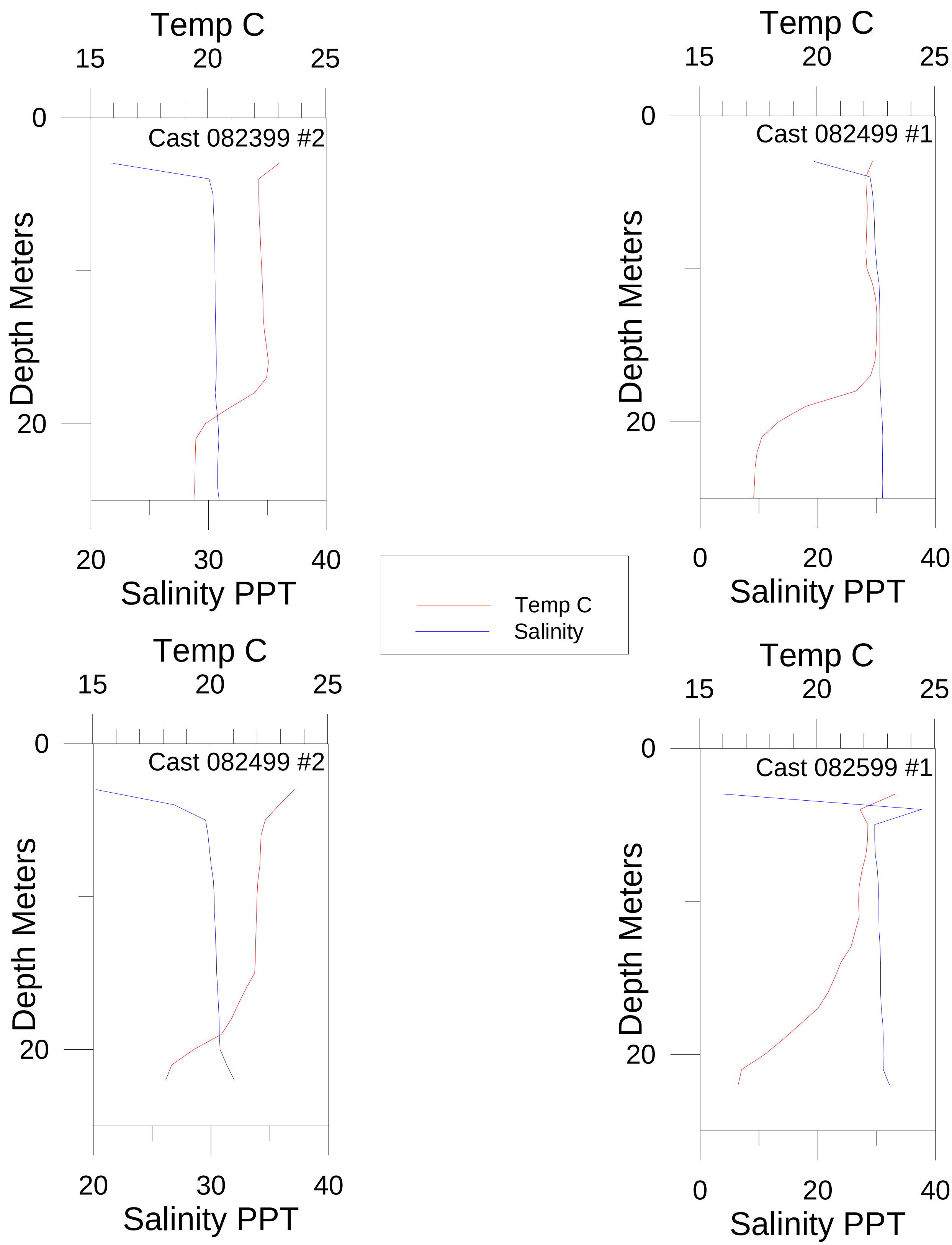
Depth vs Temperature and Salinity



Depth vs Temperature and Salinity



Depth vs Temperature and Salinity



Depth vs Temperature and Salinity